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ABSTRACT

This paper reviews studies on cognitive processes that may mediate the development of early learning problems. Topics covered include auditory and visual discrimination deficits, integration of information from different modalities, the significance of attentional factors, contributions of memory factors, and the importance of cognitive style dimensions such as field dependence and reflectivity/impulsivity. These studies, which used high risk and control groups, each yielded a significant difference. High risk children manifested deficits in recall, in visual sequential memory, in attention, and in perceptual discrimination, and showed greater impulsivity in their cognitive styles than other children. Relationships among these psychological variables are discussed briefly, and it is suggested that further study is required to examine the link between reading performance and cognitive deficits. (GO)

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Cognitive Correlates of Learning Problems:

Some Implications for Early Identification and Intervention:

Ruth Forer, James Miller & Williamson Fuller

Early identification of children who may have learning problems in school implies understanding the nature of the cognitive processes which mediate the development of these problems. One central aim of the Prediction and Prevention of Early Reading Failure Project at U.C.L.A. has been to explore specific mechanisms which may underlie the learning and performance deficit observed in the High Risk children and in their subsequent reading performance. What are basic and what are secondary mediating cognitive mechanisms is an admittedly difficult question to resolve. The studies to be summarized here, while addressed to only a few of the cognitive processes that have been implicated in early learning deficits, provide some indicators bearing on the thorny issue of basic mechanisms. Secondly, they also touch upon the question of specificity of mechanisms and specificity of intervention effort.

These studies, completed during the past four years, have been carried out in the context of a burgeoning research interest in the relationship of varied cognitive processes which may mediate the development of learning problems. Relatively early in experimental research in this problem area, investigators examined the role of auditory and visual discrimination, the data suggesting that auditory and visual discrimination deficits are central to learning problems (e.g., Birch & Belmont, 1965; McGrady & Olson, 1970). Related to the research on specific modality input deficits were a number of studies concerned with the

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relationship to reading competence of difficulties in the integration of information from different modalities (e.g., Birch & Belmont, 1965; Senf, 1969, Senf & Feshbach, 1970; Senf & Freundl, 1971). Most recently there has been considerable interest in the significance of attentional factors, particularly in regard to the learning competencies of the young primary school child. The possible contributions of memory factors, including organizational properties and sequential recall, have also been examined in a substantial number of studies (e.g., Guthrie & Goldberg, 1972; Rizzo, 1939). Still another cognitive source of variance which has attracted a great deal of attention are "cognitive style" dimensions, such as field dependence-independence, and reflectivity-impulsivity.

In conjunction with the overall project interest in the development of learning competencies and deficits in high risk and control children, a variety of studies assessing differences between these groups in several of these cognitive functions and styles were carried out. These studies also provided an opportunity to assess the predictive value of specific cognitive deficits.

One group of studies focused on the nature of memory functions. In accord with other findings, deficits in visual and auditory memory in the high risk, reading problem children were observed (Alworth, 1974; Dougher, 1972; Luick & Feshbach, 1974). Of particular interest were the data yielded by a study of visual sequential memory (Luick & Feshbach, 1974). In this study, twenty-six first and second grade children identified as "high risk", and already displaying reading problems, were compared with twenty-nine "normal" children who were not predicted to have (and were not displaying) reading difficulties. "High risk" children had been designated on the basis of ratings of their classroom behavior by their kindergarten teacher on the Student Rating Scale (Adelman & Feshbach, 1969; Feshbach & Adelman, 1971; Feshbach, Adelman, & Fuller, 1974), and by passing 4 or less of the 5 subtests on the individually administered Diagnostic Battery for Predicting Reading Failure developed by de Hirsch and Jansky (de Hirsch, Jansky & Langford, 1966; Jansky & de Hirsch, 1973).

For this experiment, "high risk" and "normal" children were individually matched for age, sex, grade, and IQ. All children were administered a visual sequential memory task consisting of 32 cards, each with a random sequence of letters and numbers printed on it. Each card was shown tachistoscopically at intervals of .10 second and 1.0 second. The stimuli for half the cards were color-coded while the stimuli in the other half were printed in black. The results indicated that high risk children made significantly more errors than the matched normal children at both the .10 second and the 1.0 second exposure intervals ($p < .0001$). Second graders (from both groups) had more accurate visual sequential memory than first graders ($p < .001$), but normal first graders performed slightly better than high risk second graders. The mnemonic strategy of color-coding actually proved disruptive, especially for the high risk children. For the second phase of the experiment, systematic training in visual sequential memory was given to all high risk children. The training consisted of brief, increasingly difficult visual sequential exercises for about five minutes a day over a five day period. All sessions were conducted individually. The finding that after this relatively short training period, high risk children were able to perform on the sequential memory task at the same level as the normal controls, strongly suggests that the process mediating their prior poor performance is not a basic memory deficit but rather is more like a behavior control and attentional problem.

Further evidence for behavior control problems within the high risk population was provided by data originally collected by Sones (1973) in connection with a study of cognitive styles. The present authors reanalyzed the data, using different criteria for determining high risk, both methods of analysis yielding similar findings. Measures of cognitive style were administered to 110 kindergarten children, 22 of whom were in the reanalysis subsequently designated "high risk" on the basis of SRS and de Hirsch data. These children were given the Portable Rod and Frame test (Nickel, 1970), the Matching Familiar Faces Test (Kagan, 1965) and the Macoby

Draw-a-Line Slowly measure (Maccoby, 1966). High risk children responded in significantly less time than low risk children on the Draw-a-line Slowly test (High Risk = 45.00 seconds vs. Low Risk = 70.58 seconds-- $t=2.62$, 108df, $p<.01$), with significantly more errors on the Matching Familiar Faces measure, (High Risk = 25.96 errors vs. Low Risk = 20.86 errors-- $t=3.19$, 108df, $p<.002$), and significantly shorter latencies on the same measure, (High Risk = 47.48 seconds vs. Low Risk = 66.52 seconds-- $t=2.15$, 85df, $p=.034$). Differences between the high risk and low risk child on the Rod and Frame were not significant ($t=0.72$). This instrument proved especially difficult for kindergarten children to grasp. It may be diagnostic that 17% of the low risk children failed to produce a scorable protocol, while fully 36.4% of the high risk children were unable to do the task ($p<.06$), suggesting that the task was too difficult for many of the high risk children. As a whole, these data imply that high risk children are impulsive and tend not to respond deliberately even when explicitly instructed to do so.

In a follow-up study, it was found that latencies on the Matching Familiar Faces test correlated substantially and consistently with later reading achievement--.30 with First Grade reading, .39 with Second Grade reading and .21 with Third Grade reading ($p<.01$) the last becoming nonsignificant when I.Q. is controlled. While the effects of cognitive styles assess at kindergarten may decline as the child advances through elementary school, the data indicate that a child's ability to control behavior and inhibit impulsive response tendencies is an important variable in determining the child's ability to master the relatively complex cognitive task posed by reading.

The importance of the behavior control-attention variable received additional support in a study by Friar (1973) delineating subgroups of high risk children. The Student Rating Scale was used to designate a group of 20 children with predominantly perceptual discrimination problems, and a second group with behavior-attention problems. Comparison of the responses of these two groups with a matched control on two measures of attention and two measures of

perceptual discrimination yielded significant differences consistent with the factorially determined subgroup deficit. Of greater importance was the results of a training program designed to improve learning of an experimental cognitive task. Half of each "deficit" group was given attentional training while half was given discrimination training. The attention training was a vigilance task where the child was required to report the occurrence of the target. The children were reinforced with a token whenever they correctly reported a target. The tokens could be later traded for prizes. The perceptual discrimination training involved reinforcing the children for making designated discriminations among sets of visual stimuli, the children being taught to look for distinctive features of the stimuli. Following only 15 minutes of this differential training program, 10 minutes on the first day and five minutes on the second, a learning task was administered to both groups. The results revealed significantly better performance for the behavior deficit group with attentional as compared to perceptual discrimination training, and significantly better performance for the perceptual deficit group with perceptual discrimination than with attentional training. These data highlight the need for more precise identification of the nature of a learning deficit, and indicate that the delineation of subgroups, as compared to a catch-all label of "high risk" or "learning disability" has functional implications for treatment programs.

Follow-up studies of the original Friar (1973) population indicate a persistence and continuity in the differential behavior patterns displayed by these two sub-groups within the High Risk population. First grade teachers rated the "Behavior deficit" children as more angry or defiant than high risk "Perceptual" children, and as having more problems in impulse control and classroom behavior management. Similar findings were obtained for the second and third grades, although the third grade difference was not statistically significant. The counterpart is obtained for ratings of perceptual discrimination skills, with the kindergarten perceptual deficit group receiving lower ratings of perceptual performance than the behavior deficit group

in the first and second grades, with no difference obtaining in the third grade. A follow-up of the reading performance of these two high risk groups reflects lower reading achievement scores than the matched controls for both groups through the third grade, while the behavior problem group manifests less of a reading deficit than the perceptual problem group in the first and second grades. The difference disappears by the third grade.

These data indicate that the differentiation of subgroups within the high-risk children includes one group for whom the primary cognitive problem appears to be attentional and a second group for whom the major difficulty is perceptual. This distinction appears to be a functionally useful one for the early primary grades. By the third grade, the distinction in mediating cognitive mechanisms made at kindergarten loses its significance as undoubtedly other cognitive and attitudinal processes mediating reading performance come to the fore.

In reviewing the results of these varied experimental studies, we find, like many other investigators in this area, that we may be suffering from a plethora of riches. Each process that one examines yields a significant difference. High risk children manifest deficits in recall, visual sequential memory, attention, and perceptual discrimination, and, in addition, manifest significantly greater impulsivity in their cognitive styles. However, one can discern a thread of commonality in many of these findings. Thus, attentional processes appear to be a major mediating factor being reflected in cognitive styles, in the training of visual sequential memory, and in the performance of high risk children with particularly low scores on the Behavior-control factor of the Student Rating Scale. There also is evidence of distinctive cognitive mechanisms, attentional and perceptual, which are responsive to distinctive remedial procedures.

However, as is true for much of the research on cognitive processes, the link between these cognitive deficits and their remediation, on the one hand, and reading performance, on the other, is not clearly established. Further research is

needed to delineate this link and to determine how the relationships between different cognitive processes and reading competence change as a function of broader developmental changes.

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